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ORIGINAL RESEARCH

Cardiology

Lack of benefit from hospitalization in patients with syncope: A propensity analysis

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Abstract

Study Objective: Patients with syncope are frequently admitted to the hospital, but whether this improves outcome is unknown. We tested whether hospitalization reduced mortality in patients who presented to emergency departments (EDs) with syncope.

Methods: We conducted a propensity analysis of the outcomes of patients ≥18 years old presenting to EDs with a primary diagnosis of syncope in April 2004–March 2013. The model used 1:1 nearest-neighbor matching to predicted admission using age, sex, urban residence, household income, and 14 significant comorbidities from 4 administrative databases of the province of Alberta. The primary outcome was death.

Results: There were 57,417 ED patients with a primary diagnosis of syncope; 8864 were admitted, and 48,553 were discharged in <24 hours. Admitted patients were older (median 76 vs 49 years), male (53% vs 45%), rural (23% vs 18%), and had lower income (median $58,599 vs $61,422); all $P < 0.001$. All comorbidities were higher in admitted patients (mean Charlson scores, 1.9 vs 0.7; $P < 0.001$). The propensity-matched hospitalized patients had higher 30-day mortality (3.5% vs 1.0%) and 1-year mortality (14.1% vs 8.6%); both $P < 0.001$. Mortality in all propensity quintiles was higher in the hospitalized group (all $P < 0.001$). The most common causes of death in 2719 patients included chronic ischemic heart disease, 14%; lung cancer, 7.1%; acute myocardial infarction, 6.9%; stroke, 3.7%; chronic obstructive pulmonary disease, 3.6%; dementia, 2.6%; and heart failure, 2.5%.

Conclusions: Hospital admission did not reduce early or late mortality in patients who presented to the ED with syncope. Mortality is associated with comorbidities.

KEYWORDS
emergency department, hospitalization, mortality, propensity analysis, syncope

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1 | INTRODUCTION

1.1 | Background

The assessment and care of patients who present to emergency departments (EDs) with syncope continues to be problematic. The volume is high, with syncope accounting for >1% of ED visits. Estimates of the proportion of visits range from 0.6% to 1.0% in North America and 0.9% to 1.7% in Europe.[1,2] Accurate, timely, and efficient delivery of health care for syncope continues to be a significant challenge.[3] The concerns for physicians in the ED include the large number of potential etiologies, the generally benign nature of most syncope syndromes, the occasional high-risk cause, and the increased complexity and fewer symptom clues in older patients.[4,5]

1.2 | Importance

These factors can lead to admission rates that range from 10% to 15% in some Canadian provinces,[6] to 25% to 40% in many centers in one recent report,[7] and to as high as 54% in a large, urban American teaching hospital.[8] Efforts are underway in several centers to reduce these rates,[9] but the minimal proportion of patients that should be admitted is unknown. The 1-year mortality of hospitalized syncope patients[9] is 10% to 20%, and whether hospitalization improves this is unknown. There have also been no randomized or controlled studies, and without preliminary evidence such studies would be difficult to propose or conduct. Administrative data provide one such source of evidence.

1.3 | Goals

To address whether admission improves fatal outcomes, we conducted a propensity analysis[10] of administrative data of patients with syncope in all Alberta EDs from 2004 to 2012. The primary outcomes were mortality at 30 days and 1 year.

2 | METHODS

2.1 | Study design and setting

We conducted a retrospective cohort study using 4 linked Alberta health administrative databases. They were the Ambulatory Care database, which includes ED visits; the Discharge Abstract Database, which documents all acute care hospitalizations; and the Population Registry and Vital Statistics, which provide patient demographics and death records. The databases were linked with anonymous patient unique identifiers. We separately used ED and hospital discharge diagnosis codes to classify the discharge diagnosis. The University of Alberta Health Research Ethics Board approved the study (institutional review board number Pro00010852).

The Bottom Line

Patients presenting to the emergency department with syncope are often admitted for further monitoring and testing. In this propensity-matched study, admitted patients were older, had more comorbidities, and had higher rates of mortality (30 days and 1 year). Hospital admission did not reduce mortality in this cohort.

2.2 | Selection of participants

We included all patients aged ≥18 years who were admitted to EDs in Alberta between April 2004 and March 2013 with a primary diagnosis of syncope (*International Classification of Diseases Tenth Revision* code R55).[11] Patients were categorized into those who were hospitalized within 24 hours of ED visit and those who were discharged home. If a patient had more than 1 ED visit during the study period, only the first visit was selected. Patients were followed for 1 year.

2.3 | Measurements

The second digit of the Canadian postal code classified the patient residence as either urban or rural. Patient socioeconomic status was based on the 2006 Canadian census.[12] The hospitals in which patients were admitted were categorized into teaching, community large, community medium, and community small hospitals according to the Canadian Institute for Health Information criteria. The EDs were grouped based on type of hospital (teaching/community large/community medium/community small) or a stand-alone facility. We used previously validated *International Classification of Diseases* codes to identify patient comorbidities.[13] A comorbidity was considered present if it was recorded in either an ambulatory care visit or a hospitalization record during the 3 years before the ED index visit. All analyses were performed using Stata version 14 (Stata Corp., College Station, TX); P values < 0.05 were considered significant.

2.4 | Objective measures

The primary outcomes were all-cause mortality at 30 days and 1 year. Causes of death were determined from *International Classification of Diseases Tenth Revision* codes in the Vital Statistics registry.

2.5 | Primary data analysis

Patient characteristics of the 2 cohorts were compared using the χ^2 test for categorical variables and the Kruskal-Wallis test for continuous variables. We used a logistic regression model with hospital

admission as the outcome variable, and fiscal year of ED visit, patient sex and age, location of the ED, and comorbidities as the independent variables were used to calculate the propensity score. In the model in which we examined the association between admission versus discharge status on mortality, all patient-level variables as well as the propensity score were included as independent variables. Backward stepwise selection was used. We used likelihood ratio tests to examine the inclusion of other independent variables that could have an effect on the likelihood of hospital admission. They were comorbidities, urban/rural residence, ambulance or self-presentation, median household income quartiles (at forward sortation area, ie, neighbourhood level), and sex and age interactions. These variables remained in the final model if the likelihood ratio test was significant at a 5% level. Patients of the 2 cohorts were matched 1:1 with a caliper (0.25 of SD) into 5 quintiles based on the nearest propensity for hospital admission. To account for early death during hospitalization, we performed a sensitivity analysis wherein only survivors of the index hospitalization (8803 patients) were used for propensity matching with their discharged counterparts. A balancing test was used to confirm bias reduction after propensity matching. All analyses were performed using Stata version 14 (Stata Corp., College Station, TX); P values < 0.05 were considered significant.

3 | RESULTS

3.1 | Characteristics of study subjects

There were 57,429 ED patients with a primary diagnosis of syncope from April 2004 to March 2013, of whom 12 died at the index ED visit and were excluded. Of the remaining 57,417 patients, 8864 (15%) were admitted to the hospital and 48,553 (85%) were discharged from the ED (Table 1). Admitted patients were older (median 76 vs 49 years; $P < 0.001$), more likely male (53% vs 45%; $P < 0.001$), and more likely rural (23% vs 18%; $P < 0.001$). Admitted patients had lower median household incomes ($58,599 vs $61,422; $P < 0.001$). All comorbidities were significantly higher in admitted patients, and Charlson scores were higher in admitted patients (mean scores 1.9 vs 0.7; $P < 0.001$). Patients who arrived by ambulance were more likely to be admitted (63% vs 42%). Patients who presented to teaching hospitals were less likely to be admitted (42% vs 48% of admitted or discharged patients), whereas patients who presented to community hospitals were more likely to be admitted (57% vs 49% of admitted or discharged patients).

3.2 | Main results

Of the 8864 hospitalized patients, 3843 (43.4%) were eventually discharged with a diagnosis of syncope and 5021 (56.6%) were eventually discharged with another diagnosis being listed as the primary cause for hospitalization (Table 2). These included hypotension (I95, 6.2%), other cardiac arrhythmias (I49, 4.8%), and ICD10 category for abnormalities of heartbeat (R00, 3.9%)

Overall, 3.6% and 0.3% of admitted and discharged patients, respectively, died within 30 days of the index ED visit ($P < 0.001$). By 1 year, the mortality rates had increased to 14.3% and 3.0% for admitted and discharged patients, respectively ($P < 0.001$). The most common causes of death (Table 3) were chronic ischemic heart disease, 14%; lung cancer, 7.1%; acute myocardial infarction, 6.9%; stroke, 3.7%; chronic obstructive pulmonary disease, 3.6%; dementia, 2.6%; and heart failure, 2.5%.

We created cohorts of 8804 admitted and discharged patients matched on their propensity for hospitalization. Variables of the logistic regression model that predicted propensity to hospitalization are presented (Table 1). The model predicted admission with a C statistic = 0.79. The propensity quintiles of ascending likelihood to be hospitalized were significantly associated with increased 1-year mortality (second quintile odds ratio [OR] = 3.5, third quintile OR = 5.0, fourth quintile OR = 7.3, fifth quintile OR = 14.9; all $P < 0.001$; compared with first quintile). Both the 30-day mortality (3.5% vs 1.0%; $P < 0.001$) and 1-year mortality (14.1% vs 8.6%; $P < 0.001$) continued to be higher in admitted patients compared with discharged patients. The 30-day and 1-year mortality in all 5 matched quintiles of propensity for hospitalization were higher in the hospitalized group (Figure 1). At both times and in all quintiles, the patients who were admitted to the hospital were at statistically significant increased risk of death. Comparing unmatched to matched analyses, identifiable baseline risk factors were only associated with a minority of the increased risk borne by admitted patients compared with discharged patients, 1% of the 3.5% 30-day mortality (29% of risk), and 8.6% of the 14.1% 1-year mortality (61% of risk).

In a sensitivity analysis, 8564 of 8603 hospital survivors of the index hospital admission were matched with their counterparts who were discharged alive from ED. Survivors of patients who were hospitalized had a higher 1-year mortality in all quintiles than matched patients who were discharged from the ED (Figure 2). Therefore, the propensity to being admitted predicts 1-year mortality even after accounting for early in-hospital mortality.

4 | LIMITATIONS

There are notable limitations. First, these are administrative data, and the interpretation of the results depends on the accuracy and thoroughness of coding, which may lead to misclassification. For example, the *International Classification of Diseases Ninth Revision* code for syncope has a 99% specificity but only 65% sensitivity.[11] Second, it is from a single Canadian province of about 4 million people, and its geographic, demographic, and income social determinants may not extrapolate completely to other settings. However, it is a broad-based study that is directly relevant to the disposition of patients in the ED, as the diagnostic code encompasses both syncope and collapse, which are the diagnostic challenges facing emergency physicians. We only included patients with a primary diagnosis of syncope. Therefore, patients with other diagnoses (such as dehydration, arrhythmia, or transient ischemic attack) in the primary diagnosis field with syncope listed as a secondary diagnosis in the ED record were not included.

TABLE 1 Baseline variables in all patients who were either discharged from or admitted through emergency departments and the corresponding propensity-matched populations in Alberta, Canada, 2004 to 2012

Variable	Hospitalized cohort 1, n = 8,864	Discharged cohort 2, n = 48,553	*P* value	Propensity admitted cohort, n = 8,804	Propensity discharged cohort, n = 8,804	*P* value
Demographic characteristics						
Age, y, mean (SD)	71.1 (16.7)	50.5 (22.2)	<0.001	71.1 (16.8)	71.3 (16.8)	0.414
Age, y, median (IQR)	76 (62–83)	49 (30–70)	<0.001	75 (62–83)	76 (62–83)	0.292
Age group, n (%)						
<40 years	537 (6.1)	18,296 (37.7)	<0.001	537 (6.1)	496 (5.6)	0.313
40–49 years	502 (5.7)	6086 (12.5)	<0.001	502 (5.7)	470 (5.3)	0.291
50–59 years	931 (10.5)	6566 (13.5)	<0.001	931 (10.5)	884 (10)	0.224
60–69 years	1270 (14.3)	5334 (11.0)	<0.001	1268 (14.4)	1235 (14)	0.476
70–79 years	2241 (25.3)	5799 (11.9)	<0.001	2229 (25.3)	2243 (25.5)	0.808
≥80 years	3383 (38.2)	6472 (13.3)	<0.001	3337 (37.9)	3476 (39.5)	0.031
Male, n (%)	4685 (52.9)	21,689 (44.7)	<0.001	4641 (52.7)	4613 (52.4)	0.673
Urban residence, n (%)	6811 (76.8)	39,654 (81.7)	<0.001	6775 (77)	6783 (77)	0.886
Charlson score						
0	3521 (39.7)	34,419 (70.9)	<0.001	3521 (40)	3913 (44.5)	<0.001
1–2	2860 (32.3)	9830 (20.3)	<0.001	2860 (32.5)	2703 (30.7)	0.011
3–4	1257 (14.2)	2365 (4.9)	<0.001	1249 (14.2)	1049 (11.9)	<0.001
≥5	1226 (13.8)	1939 (4.0)	<0.001	1174 (13.3)	1139 (12.9)	0.435
Comorbidities						
Hypertension	3776 (42.6)	8328 (17.2)	<0.001	3720 (42.3)	3675 (41.7)	0.492
Myocardial infarction	1207 (13.6)	2077 (4.3)	<0.001	1165 (13.2)	1099 (12.5)	0.137
Congestive heart failure	1463 (16.5)	1896 (3.9)	<0.001	1403 (15.9)	1265 (14.4)	0.004
Peripheral vascular disease	622 (7.0)	1044 (2.2)	<0.001	592 (6.7)	572 (6.5)	0.544
Cerebrovascular disease	1286 (14.5)	2752 (5.7)	<0.001	1256 (14.3)	1230 (14)	0.574
Dementia	643 (7.3)	1406 (2.9)	<0.001	640 (7.3)	636 (7.2)	0.907
Chronic pulmonary disease	1613 (18.2)	4665 (9.6)	<0.001	1576 (17.9)	1469 (16.7)	0.033
Rheumatoid disease	222 (2.5)	479 (1.0)	<0.001	216 (2.5)	206 (2.3)	0.622
Peptic ulcer disease	260 (2.9)	699 (1.4)	<0.001	257 (2.9)	209 (2.4)	0.024
Mild liver disease	178 (2.0)	442 (0.9)	<0.001	165 (1.9)	156 (1.8)	0.612
Diabetes	1916 (21.6)	4487 (9.2)	<0.001	1877 (21.3)	1743 (19.8)	0.012
Hemiplegia or paraplegia	147 (1.7)	355 (0.7)	<0.001	144 (1.6)	155 (1.8)	0.521
Renal disease	798 (9.0)	1282 (2.6)	<0.001	767 (8.7)	710 (8.1)	0.121
Cancer	792 (8.9)	1750 (3.6)	<0.001	777 (8.8)	748 (8.5)	0.437
Moderate/severe liver disease	58 (0.7)	98 (0.2)	<0.001	48 (0.6)	52 (0.6)	0.688
Metastatic solid tumor	263 (3.0)	502 (1.0)	<0.001	256 (2.9)	252 (2.9)	0.857
AIDS	3 (0)	30 (0.1)	0.313	3 (0.03)	0 (0)	0.083

IQR, interquartile range; SD, standard deviation.

Conclusions from propensity analyses depend importantly on the baseline factors, and there is a risk that important factors such as frailty were not captured. We did include a broad range of baseline demographic, clinical, and geographic factors. There is no evidence about the history and clinical details of the index syncopal spell, and this information may have both informed the decision to admit and predicted subsequent outcome. This article therefore complements the findings of Probst et al,[10] who included patient-specific variables in their analyses. Ours is population based using administrative data, whereas their study focused on a smaller and highly relevant population of older syncope patients. Our outcomes did not include morbidities, procedures, quality of life, or costs, but did focus on the worst and most definitive

TABLE 2 Top 10 discharge diagnoses of the 8864 hospitalized patients

Coded diagnosis	N (%)
Syncope	3843 (43.4)
Hypotension	313 (3.5)
Other cardiac arrhythmias	241 (2.7)
Abnormalities of heart beat	197 (2.2)
Dizziness and giddiness	195 (2.2)
Atrial fibrillation and flutter	183 (2.1)
Atrioventricular and left bundle-branch block	167 (1.9)
Transient cerebral ischaemic attacks and related syndromes	105 (1.2)
Acute myocardial infarction	105 (1.2)

TABLE 3 Top 10 coded causes of death (n = 2719)

Coded cause of death	N (%)
Chronic ischemic heart disease	379 (14)
Malignant neoplasm of bronchus and lung	194 (7.1)
Acute myocardial infarction	188 (6.9)
Stroke, not specified as hemorrhage or infarction	99 (3.7)
Other chronic obstructive pulmonary disease	97 (3.6)
Unspecified dementia	70 (2.6)
Heart failure	69 (2.5)
Malignant neoplasm of colon	64 (2.4)

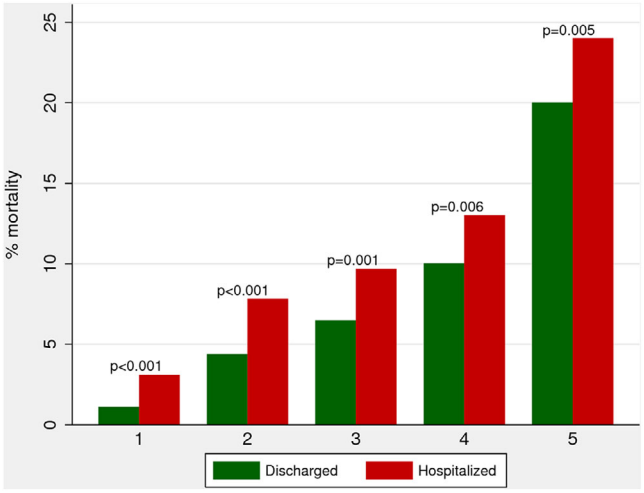

FIGURE 2 One-year mortality of the matched cohort by quintiles of propensity for hospital admission for index hospital survivors and matched discharged patients

of outcomes: death. Finally, we did not analyze specific causes of death, and it might be that some causes of death are reduced by admission.

5 | DISCUSSION

5.1 | Summary

This propensity analysis of large administrative data could not find benefit of hospitalization for syncope patients who present to the ED. The

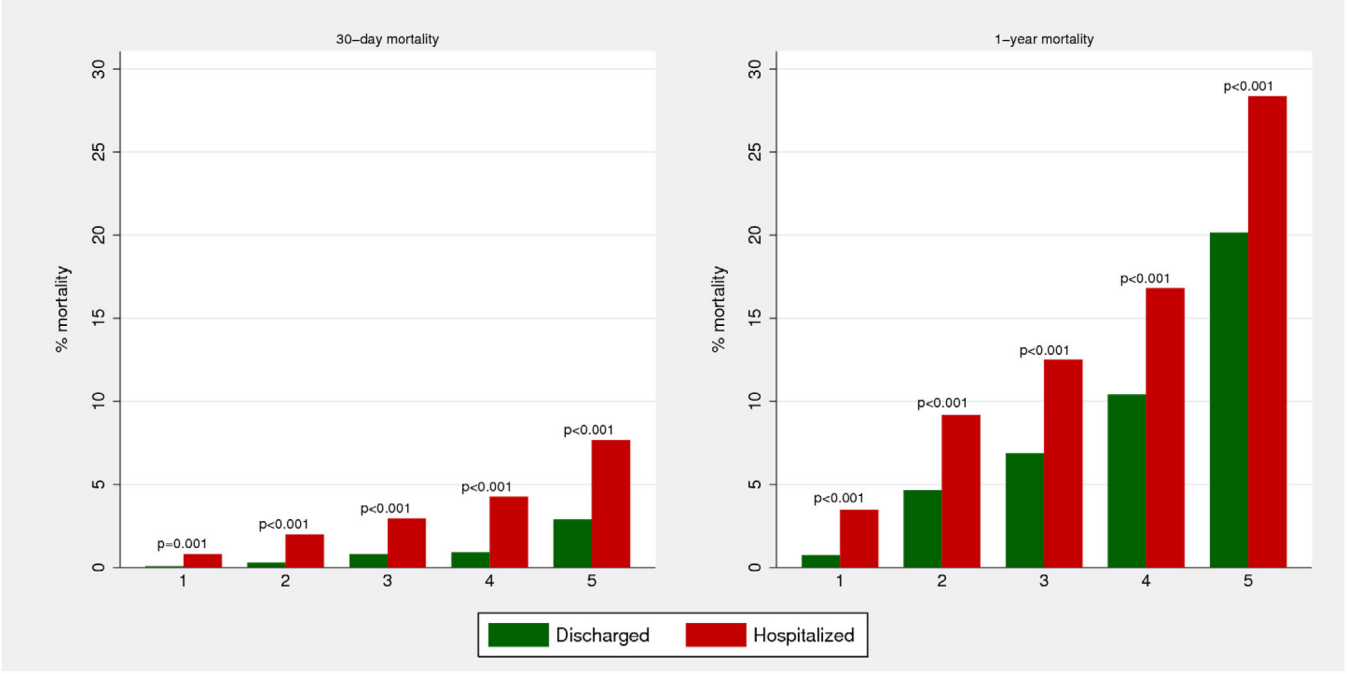

FIGURE 1 Left: 30-day mortality in matched cohorts who were discharged from the emergency department or admitted to the hospital. Right: 1-year mortality in matched cohorts who were discharged from the emergency department or admitted to the hospital

results agree with those of Probst et al,[10] who also could not identify a benefit to 30-day survival in older patients with syncope. This lack of evidence of a benefit of hospitalization stands in contrast to high admission rates for syncope in the United States,[8] Europe, and the United Kingdom.[3] This analysis featured large cohorts with few exclusions, sampling over 10 years, and the use of the hardest of outcomes: 30-day and 1-year mortalities. Its internal validity was strengthened by the association of increased propensity to admission and increased likelihood of death. Its external validity was highlighted by the report of Probst et al,[10] which focused on elderly patients and had several morbidity and mortality outcome measures and also could find no benefit from hospitalization.

5.2 | Context

The mortality of Canadian syncope patients is high and aligns well with those from previous smaller studies. Costantino et al[14] reported 1-year mortalities of 2% and 16% in Milan ED syncope patients who were discharged from ED or admitted to the hospital. Similarly, Del Rosso et al[15] reported an 8% 1-year mortality in syncope patients admitted through the ED to the hospital. The Osservatorio Epidemiologico sulla Sincope nel Lazio (OESIL) investigators[16] reported a 25% 1-year mortality in syncope patients admitted to the hospital. Solbiati et al[17] reported a systematic review and meta-analysis of the outcomes of syncope patients seen in the ED. There was an overall estimated 1-year mortality of 8.3%. The 1-year mortality in this population approximates those of patients with heart failure[18] or survivors of sudden death,[19] and although much ongoing work is currently focused on preventing unnecessary admissions, these findings suggest the importance of also focusing on identifying and treating this high-risk group.[7,9]

The causes of death also resemble those in the Evaluation of Guidelines in SYncope Study (EGSYS) study,[20] which reported that 18 of 40 deaths were attributed to cardiovascular or cerebrovascular causes. Advancing age carries increasingly high ORs, but clinical components are also important. Many of the clinical components in the propensity score are not known risk factors for syncope, suggesting that emergency physicians may be admitting patients on the basis of their perceived overall health status rather than for specific assessment of the cause of syncope. Supporting this is the observation that across all risk-adjusted quintiles patients who were admitted to the hospital had a higher mortality than patients who were discharged from the ED. Given the unlikelihood that hospitalization could increase the mortality of patients between 30 days and 1 year, this suggests the presence of other, uncoded risk factors for 1-year mortality that also increase the likelihood of admission to the hospital. One possibility is frailty, whose components regardless of how it is measured may not be diagnostic codes.[21] It is widely if imperfectly recognized at the bedside,[22] is a phenotype that resembles heart failure, and raises appropriate concerns that it portends a poor outcome.[22]

Whether syncope itself is a risk factor for death cannot be determined directly from these data. However, there were only 48 deaths by 1 year in the lower 2 quintiles, with a mortality of 0.2%, and mortality generally rose monotonically with the propensity score. This low mortality in patients with few comorbidities suggests that at least in this group syncope is not a risk factor for death. Whether this is also true in patients with several comorbidities and advancing age cannot be estimated without a direct, prospectively assessed comparison group. Determining whether syncope itself is a generalized risk marker such as frailty[22] of a poor outcome remains to be determined.

These findings have several clinical and health service implications. First, current international efforts are focused on preventing unnecessary admissions, and these data suggest the need for efforts to also address identifying, assessing, and treating high-risk patients.[7,9] Many of the deaths may be attributed to preventable cardiovascular or cerebrovascular causes. Second, the range of components in the propensity model for admission suggests that emergency physicians are making broad risk assessments of the patients rather than focusing on simply determining the risk level and etiology of the index syncopal spell. Efforts should address what other factors go into their assessments other than those that appear as diagnostic codes. In particular, whether a bedside assessment of frailty is involved is unknown.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Padma Kaul, Dat T. Tran, Roopinder K. Sandhu, Monica Solbiati, Giorgio Costantino, and Robert S. Sheldon conceived and designed the study. Padma Kaul, Roopinder K. Sandhu, and Robert S. Sheldon obtained research funding. Padma Kaul, Dat T. Tran, and Roopinder K. Sandhu supervised data collection, and Dat T. Tran and Padma Kaul analyzed the data. Robert S. Sheldon provided the first draft, and all authors contributed heavily to its revisions. Robert S. Sheldon takes responsibility for the article as a whole.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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